DOCUMENT RESUME

ED 124 063 HE 007 917

AUTHOR	Rao, K. N.
TITLE	Collaboration in Science and Technology. An Inter-American Perspective. Issues in International Education Report No. 4.
INSTITUTION	Institute of International Education, New York, N.Y.
PUB DATE	75
NOTE	12p.
AVAILABLE FROM	Institute of International Education, 809 United Nations Plaza, New York, N.Y. 10017 (free)
EDRS PRICE	MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS	College Science; Developing Nations; *Higher Education; Latin American Culture; Science Curriculum; *Science Education; Science Facilities; Science Institutes; Science Instruction; Scientific Attitudes; *Scientific Research; *Technical Education; Technological Advancement; Technology; *Universities
IDENTIFIERS	*Latin America

ABSTRACT

Political events in Latin America in recent years have caused universities to re-examine their goals and external relationships, especially in terms of science and technology. The reexamination has led to a renewed stress on basic science education and an explosive growth of graduate education. In view of these structural changes, almost every Latin American country has established a national council of science and technology to provide support for scientific and technological research in the universities. Parallel to the research councils are the national associations of universities and the councils of rectors charged with the task of allocating national funds to universities, courses and programs. What is needed now is greater hemispheric collaboration, increased technology transfer, and interaction in the area of scientific and technological policy studies as well as innovations in funding of research. (JMF)

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ED124063

Issues in
International Education
Report No. 4

Collaboration in Science and Technology

An Inter-American Perspective

by K. N. Rao

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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The publication of this series of papers reflects the Institute's continuing concern with the critical issues in international education. In recent years this concern has been expressed particularly through the Institute's sponsorship of the International Councils on Higher Education, which bring together chief executives of universities in the U.S. and other regions of the world for examination of topics of shared interest. Essays prepared as subjects for discussion at these conferences will form a portion of the series, which will draw upon other resources as well.

The past two decades have been a period of enormous growth in education throughout the world. As the role of education has increased in dimension, the choices involved in educational decision-making have increased in complexity and in social impact. It is hoped that this series will contribute to the ongoing debate on the issues of international education through examination of alternative viewpoints and through the publication of new information. As international education in our era has broadened its scope beyond traditional activity to include developmental assistance and other concerns, the range of topics covered in the series will reflect this breadth of interests in the field.

Papers in this series are prepared under the direction of the Office of Planning and Analysis, the program planning and development arm of IIE.

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Collaboration in Science and Technology

An Inter-American Perspective

by K. N. Rao

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This essay was the subject of discussion at the 1975 Mexico conference of the Council on Higher Education in the American Republics. The meeting was the seventeenth in an annual series of inter-American educators conferences, and was organized by IIE through a grant from the Tinker Foundation of New York.

I. Changed Structure

Declarations of Punta del Este, the Consensus of Vina del Mar, resolutions of the CACTAL Conference of Brasilia, the Andean Pact ar l the communiques of the 1974 Mexico City foreign ministers' conference are among the pronouncements that have punctuated a stormy period of inter-American relations which began in the early sixties. These documents consistently affirm the 'individual personality' of Latin America in their tone and in the new relations they seek to establish among the countries of the region, and between Latin America and the rest of the world. They reject developmental determinism and intellectual dependency as inimical to the region's development. More recently, the tides of inflation sweeping the world and the energy crisis have affected individual countries of Latin America in different ways, but in their combined effect have served to introduce new complexities into inter-American relations. The passage of the 1974 U.S. Trade Bill has turned out to be yet another pinch of salt in a festering wound.

These events are significant early indicators of the contours of the new power relations unfolding before us. In the case of Latin America they bespeak a determination to achieve new and advantageous terms of trade in technology, capitalizing on the region's natural resources, its higher level of development in comparison with other developing regions, and especially its institutional capacity to ingest new technology. In spite of diversions in the region and elsewhere from anti-science and anti-technology forces, every one of the declarations, resolutions and pacts cited above place special emphasis on the need for further rapid development of science and technology, and on the need to develop manpower, ideas, and analyses for the fulfillment of the economic and social development of the region. The Declarations of the Presidents of the American Republics assembled at Punta del Este gave impetus to a vastly expanded Regional Program of Science and Technology of the Organization of American States (OAS). The "Consensus of Vina del Mar" prescribed a specific set of actions to which the U.S. and the Latin American nations should address themselves in the areas of science and technology. The CACTAL (Conference on the Application of Science and Technology to Latin American Development) conference held in Brasilia (1972) subjected these and a variety of other ideas to vigorous debate.

Subsequent official announcements from the U.S. have re-emphasized U.S. desire to share its technology with Latin America, but concrete mechanisms and incentives to translate this desire into actionable programs have yet to appear from either side. However, articles related to the transfer of technology have become commonplace in most recent cultural and trade agreements between the U.S. and other countries.

While these major events were taking place in the political arena, Latin American universities were re-examining their goals and their external relationships. Structural changes intended to modernize traditional university structures in Latin America had yielded mixed results. Many universities had created institutes of basic sciences or established general studies programs to horizontally interconnect their disparate and vertically integrated faculties. In most cases, basic sciences and mathematics were the first disciplines around which general studies programs were built. This provided the opportunity for universities to introduce new experimental approaches to the teaching of these basic disciplines and to the modernization of facilities and curricula. The basic science institutes also provided desperately

needed underpinning for engineering programs, which also underwent updating during the late sixties and early seventies.

Basic sciences started as parts of the general studies programs, grew to become independent 'licenciatura' programs and are now providing new kinds of specialists in the basic sciences. This structural transformation is often criticized because it is an innovation patterned after U.S. models and because it might not provide the solution to all the problems of Latin American universities, many of which have their roots in the long history and culture of the continent. It would appear that structural changes introduced barely a decade ago need time to undergo additional transformation before they come to support the stable universities of the future in Latin America. The fact that certain private universities have done better in adapting these innovations than public universities might say something about the difficulty of institutional modernization in the region.

A second major change in higher education in Latin America is the explosive growth of graduate education, especially in scientific and engineering fields. Established on the basis of the urgent need for high level manpower by industry, government and higher education itself—and as a method of lifting the quality of higher education—graduate programs in the sciences and engineering have helped to develop centers of creativity in the region where none existed before. Nurtured properly, they promise to provide a network of institutions necessary not only to interact with and adapt technology from outside, but to develop technologies indigenously. Appropriateness of imported technology and the relevance of training abroad can be questioned by the developing countries *ad nauseam* but unless indigenous graduate programs and related science and technology institutions are given the freedom and incentive to attain parity with those of the developed countries, dependence will continue and autonomy will be just a slogan.

Two other institutional developments are worthy of note as we review structural changes in Latin American science and technology. Almost every country in the region now has a national council of science and technology, or will soon have one. These councils have been helpful in providing support for scientific and technological research in the universities, thereby augmenting the meager investments the universities can make in support of research out of their regular budgets. It is probably true that in several countries funds available to the research councils are not sufficient to meet even the current demand, let alone to finance major new types of activity. It may also be true that some councils have become too bureaucratized to be innovative in the support of research and in mustering support from a variety of national and international agencies to develop major programs of research. In some cases, local financing through the councils is supplemented by the OAS Regional Program of Science and Technology, the agencies of the United Nations, and by other international organizations and foundations. There is evidence, however, to indicate that in real terms the international agencies and foundations are not investing as heavily in science and technology as they did in the period 1965-70.

Parallel to the research councils are the national associations of universities and the councils of rectors. Charged with the difficult task of allocating national funds to universities, and controlling the expansion of the number of universities, courses and programs, these associations have had varying degrees of success in discharging their responsibilities. Even the developed countries with advanced systems of higher education have not had much success in controlling the growth of university systems and relating their output to national needs.

Region-wide federations of university associations have also had a checkered history. Associations such as the GULERPE (Latin American Study Group on the Reform and Improvement of Education) and UDUAL (Union of Latin American Universities) have had

great difficulty in achieving financial viability. Other university associations such as UNICA (The Association of Caribbean Universities and Research Institutes) CSUCA (The Higher University Council of Central American Universities) and CHEAR (Council on Higher Education in the American Republics) continue to render service to higher education in spite of the discontinuities in funding available to them. The potential of Latin American university associations for furthering collaboration with universities in other regions of the world deserves urgent study.

To complete this rapid review of structural changes and some of the major implications of these changes, one must note a variety of other experiments that have taken place on the Latin American higher education landscape in the last decade. Countries have cautiously moved into the realm of subprofessional technical education, as in Brazil with the Operational Engineering Program, and in Chile with the Regional College Programs of the University of Chile. Decentralization of the massive university systems in Chile and Mexico, the emergence of Latin American private foundations in a few countries, experimentation with television in higher education, reform of science curricula at the school level, and programs to link research in science and engineering at the universities with the needs of industry and government are some exciting developments in the Latin American region which brighten a picture that in the heat of confrontation politics is too often drawn in dark colors.

To this observer, the accomplishments of the past ten years in erecting an infrastructure of scientific and technological institutions have been quite substantial. The big task of putting these institutions to work to realize the social and economic objectives for which they were created lies ahead; and that is largely the responsibility of indigenous leadership. This task is a long-term undertaking and in some senses will never be completed.

Many of the development agencies which originally collaborated in the effort to build an infrastructure argue that, as far as science and technology are concerned, the Latin American region now has the institutions and competent people to man them. Therefore, it is argued, external assistance is no longer required in the same volume and for the same purposes. Provision of technical assistance and institutional development through externally supplied expertise are no longer the objectives of development agencies interested in Latin America. In fact, it is said that Latin America has much to contribute to the rest of the developing world as a laboratory of development experience. Some countries in the region now have the capacity in certain fields to render such service to other developing regions. Viewed in this perspective, 'dependencia' becomes a shop-worn idea which may have served its purpose. 'Dependencia' may be replaced by the more positive ideology of 'interdependencia,' with which Latin American universities and other scientific and technological institutions might play the truly international role to which they aspire.

Consolidation of the gains made thus far, improvement of the management of the new and the old institutions and programs, re-examination of national and institutional priorities, and the fashioning of constructive relationships with centers of intellectual activity around the world constitute a complex agenda that will keep Latin American educators busy for quite some time. This is the moment to breathe new meaning and vitality into the external relationships so that autarchic ideas and procedures will not smother intellectual interchange between the U.S., Latin America and the rest of the world.

With the expansion of Latin American universities and the development of graduate programs in the region, it is possible that in years ahead student exchange will involve a greater proportion of graduate students and senior scholars than undergraduates, although programs such as the Venezuelan government's Gran Marischal de Ayacucho Scholarship Program may

skew this trend somewhat in the near future. The travel of U.S. scholars to Latin America for research and teaching has apparently slowed quite considerably with the decrease in the number of inter-universitycollaboration programs supported by the U.S. Agency for International Development and the major foundations. However, statistics on scholarly exchange within the hemisphere have been unreliable. It is therefore quite difficult to quantify the size of the gap that may be deveioping in scholarly communication between the U.S. and Latin American countries.

Unless a new grand strategy emerges in the near future, it is perhaps unrealistic to think that external resources of the magnitude that were available during the 1960-1970 period for scientific and technological development will again be available in the next ten years. Many of the resources necessary for further development of the universities and of the research and development infrastructure are likely to be internally generated in the region. Venezuela's beneficence in sharing its new petroleum riches both through the Inter-American Development Bank and bilaterally with countries of the region is a commendable initiative. What portion of these grants and loans will go to the support of higher education and scientific and technological research and development is not yet clear.

II. Changing Priorities

Given the constraints that seem to be developing, and the lessened need for external technical assistance for institutional development, it would appear that the most meaningful kinds of relationships that Latin American universities and scientific and technological research institutions could have with their counterparts in the U.S. and elsewhere would be through collaborative research. (This does not exclude, however, the traditional exchange of teachers and students that will need to continue.)

The development of collaborative ties is not in itself a new suggestion. Such interactions have already taken place with fruitful results. Favorable conditions for interaction prevail in Latin America today. The number of competent scientists and technologists in the region has increased over the past decade, laboratory facilities have improved significantly in a dozen or more major universities and research centers, communication and data transmission facilities are being established and most importantly, research communities have identified research priorities in response to funding agency demands. Relevance of research to development needs of the nation is a criterion frequently applied by funding agencies in Latin America.

It is not my purpose here to suggest an agenda for collaborative research. Since such research assumes mutually agreed-upon goals and procedures and a division of responsibilities between the collaborators, a research agenda featuring a set of 'common' or 'convergent' program areas or themes could be easily arrived at. Social scientists have pointed out that the problems of urban congestion, maldistribution of income, alienation, population growth, environmental decay, and resource depletion are common to both developed and developing countries, and that they vary only in degree and in the intensity of their impact.

A similar set of 'convergent' problems in which science and technology play a significant role can be equally easily assembled. An agenda for collaborative research so derived would include scientific and technological research in the 'hard' senses of these terms, but would also include the 'softer' aspects dealing with societal impact of the new technologies and the policy alternatives available for consideration by decision makers in that society. Collaboration in research in the 'harder' sciences and technologies is perhaps easier than in the policy sciences, because of the longer history of scientific collaboration in the region and also because analysis of policy

alternatives requires a multidisciplinary interaction, a tradition that is only slowly being established in the region.

The choice of subjects of mutual interest available for scientific and technological research is enormous:

1. application of space age technologies for resource surveys and for educational and social applications.
2. research on ocean resources including studies of population dynamics of commercially significant varieties of krill, anchovies, shrimps and oysters.
3. development of new technologies for preservation and packaging for local distribution and for export.
4. a major program of varietal improvement of food crops drawing upon research at the two major international agricultural centers in Mexico and Columbia.
5. a scientific assault on plant and animal diseases with multinational and interdisciplinary teams.
6. a major attack on endemic diseases such as the Chagas disease.
7. further explorations into the relation between malnutrition and cognitive development (in the study of which Latin American scientists have achieved international distinction).
8. development of communications technologies, including development of Latin American capacity to move beyond assembly of consumer electronic apparatus to actual design and manufacture of the basic components.
9. encouragement of university research on 'appropriate' technologies to take advantage of the factor endowments of the countries of the region.
10. a stepped-up program of research on materials technology from steel and alloys to building construction materials.

The list could be extended. Much initial work in the areas mentioned has already been supported by the OAS Regional Program in Science and Technology, and by other assistance agencies and foundations. The need now seems to be to focus these efforts, to give them a mission orientation, and to carefully select local universities and research institutes which can assume operational responsibility for the execution of specific research projects. In the past, the process of grant-making and administration has tended to become too rigid. De-bureaucratization of the entire process is urgent if the necessary interdisciplinary and inter-institutional interaction in such problem-oriented research is to take place. As U.S. institutions now at the receiving end of research support from Latin American countries are discovering, bureaucracies everywhere have great difficulty in dealing with research communities, especially those away from their shores. The shoe pinches even on the other foot.

Equally exciting possibilities for hemispheric interaction exist in the area of scientific and technological policy studies. Stimulated by the earlier work in Europe at the Organization for Economic Cooperation and Development, and responding to the pressure within the U.S. for a re-examination of national priorities and of the role of science and technology in economic and social development, a variety of policy analysis centers have emerged on the U.S. university scene. New approaches to forecasting technology and assessing consequences of technology on society range from the highly mathematical to the heuristic. In most cases, the approach is multidisciplinary and the objective is to examine the process of decision-making in the society at large, within the scientific and technological institutional structure and at the level of the firm, and to suggest alternative policies for decision makers to ponder and to choose.

Questions related to technology transfer, costs and benefits of different investment decisions, indigenous research and development vs. importation of

technology, 'unbundling' of technology imported from outside, appropriate technologies and their costs and effects on employment generation and income distribution, the effect of government policies, incentives and disincentives for innovation at the firm level, human resource availability and newer approaches to forecasting are some of the policy questions on which university research groups could collaborate. Certain efforts have already begun in Latin American research centers—in Brazil, Argentina, Chile, Mexico and the headquarters of the Andean Pact in Lima, Peru, among others. In this rather sensitive area, collaboration could start with the sharing of methodologies (which are still in the early stages of development in the U.S. and Europe) and then lead to more substantive discussions, so that policy alternatives are illuminated prior to political confrontation based on incomplete data and analysis.

The immediate need appears to be to strengthen national policy analysis groups in the region, particularly by involving social scientists and technologists in such programs. National Research Councils are understandably more used to the idea of making research grants for scientific and technical research than they are to the idea of supporting policy-relevant research in science and technology.

A second step would be to provide for opportunities for such groups to exchange ideas and data more frequently than is now possible. The CACTAL conference provided one such opportunity. The interaction of Latin American policy research groups with their counterparts in the U.S. and elsewhere is somewhat haphazard at this point. However, the Council of the Americas has initiated a series of conversations among business leaders and is supporting some research in the academic community. U.S. universities have established degree programs in science and technology policy analysis as have some British universities, which provides an opportunity to establish further relationships.

While opportunities for collaboration in mission-oriented scientific and technological projects and policy exist, a serious information gap has developed because of the hiatus in the relations between Latin America and the U.S. Several scientific symposia with unbroken records for continuity have had to be suspended, and travel to Latin American from around the world has been affected by funding and foreign exchange problems. The Science Policy Seminars sponsored by the U.S. National Academy of Sciences in collaboration with national research councils in Latin America and the well-attended American Association for the Advancement of Science–Consejo Nacional de Ciencia y Tecnologia–conference "Man in the Americas" suggest the kinds of productive interchange that should continue if countries of the hemisphere wish not to isolate themselves from each other. A scientific weekly similar to *Nature* or *Science*, reporting on current research in Latin America, would appear to be an urgent need. Such a journal could possibly include Spanish and Portuguese abstracts of articles appearing in *Nature*, *Science* and similar U.S. and European publications.

Some innovations in funding of research in Latin America are desperately needed, especially in support of regional networking activities and information dissemination. Experience with the OAS Regional Program in Science and Technology would suggest that it is difficult to sustain research groups over time if financial support is subject to the vagaries of political decisions. New administrative methods of dovetailing actions of national research councils and regionally administered programs of assistance wherever possible would help to ensure that duplications are avoided. Alternatively, such coordination would assure that major projects are not underfinanced.

Paradoxically, while at least some Latin American countries find themselves in a position to support research activities of their scientists, U.S. scientists find themselves in the unaccustomed position of having negligible support to respond to requests for collaboration from Latin Americans, much less to initiate independent research on Latin American problems in the U.S. One hopes that this condition is transitory and that the historically strong and cordial relations among the universities of the region will endure the changes in the offing in political relationships among the nations of the hemisphere.

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The Institute of International Education was founded in 1919 to promote international understanding through education. It administers scholarship and fellowship programs for the U.S. and foreign governments, universities, foundations, corporations and international organizations, and provides support services to researchers and advisers on developmental assistance projects abroad. Seeking to promote effective educational interchange, IIE offers information and consultative services through a network of offices in the U.S. and overseas and carries on an extensive schedule of seminars and workshops. IIE acts as the parent agency for the International Councils on Higher Education, which bring together U.S. and foreign university heads and other educational policy-makers in a continuing series of conferences.

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